

# LOAN DOCUMENT

PHOTOGRAPH THIS SHEET

DTIC ACCESSION NUMBER

LEVEL

INVENTORY

*Analysis of Tracked Vehicle...*

DOCUMENT IDENTIFICATION

*NOV 84*

**DISTRIBUTION STATEMENT A**  
Approved for Public Release  
Distribution Unlimited

DISTRIBUTION STATEMENT

ACCESSION FOR	
NTIS	GRAM
DTIC	TRAC
UNANNOUNCED	
JUSTIFICATION	
BY	
DISTRIBUTION/	
AVAILABILITY CODES	
DISTRIBUTION	AVAILABILITY AND/OR SPECIAL
A-1	

DISTRIBUTION STAMP

Reproduced From  
Best Available Copy

20000203 113

DATE RECEIVED IN DTIC

DATE ACCESSIONED

DATE RETURNED

REGISTERED OR CERTIFIED NUMBER

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-FDAC

H  
A  
N  
D  
L  
E  
  
W  
I  
T  
H  
  
C  
A  
R  
E

November 1984

# Analysis of Tracked Vehicle Run-over Accidents



U.S. ARMY SAFETY CENTER



# Analysis of Tracked Vehicle Run-over Accidents

Prepared by

LTC Francis G. Sisk  
MSG William Throckmorton

June 1984

Research and Analysis Division  
Darwin S. Ricketson, Jr.  
Chief

Directorate for  
Systems Management  
Colonel J Thomas H. Denney  
Director



Colonel Joseph R. Koehler  
Commander

The views, opinions, and/or findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official authority. The findings of this report are to be used for accident prevention purposes only and are specifically prohibited for use for punitive purposes or for matters of liability, litigation, or competition.

FOR FURTHER INFORMATION CONCERNING DISTRIBUTION CALL (703) 767-8040

PLEASE CHECK THE APPROPRIATE BLOCK BELOW:

- AOR \_\_\_\_\_  
☐ \_\_\_\_\_ copies are being forwarded. Indicate whether Statement A, B, C, D, E, F, or X applies.
- ☒ **DISTRIBUTION STATEMENT A:**  
 APPROVED FOR PUBLIC RELEASE: DISTRIBUTION IS UNLIMITED
- ☐ **DISTRIBUTION STATEMENT B:**  
 DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES ONLY; (Indicate Reason and Date). OTHER REQUESTS FOR THIS DOCUMENT SHALL BE REFERRED TO (Indicate Controlling DoD Office).
- ☐ **DISTRIBUTION STATEMENT C:**  
 DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES AND THEIR CONTRACTORS; (Indicate Reason and Date). OTHER REQUESTS FOR THIS DOCUMENT SHALL BE REFERRED TO (Indicate Controlling DoD Office).
- ☐ **DISTRIBUTION STATEMENT D:**  
 DISTRIBUTION AUTHORIZED TO DoD AND U.S. DoD CONTRACTORS ONLY; (Indicate Reason and Date). OTHER REQUESTS SHALL BE REFERRED TO (Indicate Controlling DoD Office).
- ☐ **DISTRIBUTION STATEMENT E:**  
 DISTRIBUTION AUTHORIZED TO DoD COMPONENTS ONLY; (Indicate Reason and Date). OTHER REQUESTS SHALL BE REFERRED TO (Indicate Controlling DoD Office).
- ☐ **DISTRIBUTION STATEMENT F:**  
 FURTHER DISSEMINATION ONLY AS DIRECTED BY (Indicate Controlling DoD Office and Date) or HIGHER DoD AUTHORITY.
- ☐ **DISTRIBUTION STATEMENT X:**  
 DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES AND PRIVATE INDIVIDUALS OR ENTERPRISES ELIGIBLE TO OBTAIN EXPORT-CONTROLLED TECHNICAL DATA IN ACCORDANCE WITH DoD DIRECTIVE 5230.25. WITHHOLDING OF UNCLASSIFIED TECHNICAL DATA FROM PUBLIC DISCLOSURE. 6 Nov 1984 (indicate date of determination). CONTROLLING DoD OFFICE IS (Indicate Controlling DoD Office).
- ☐ This document was previously forwarded to DTIC on \_\_\_\_\_ (date) and the AD number is \_\_\_\_\_
- ☐ In accordance with provisions of DoD instructions, the document requested is not supplied because:
- ☐ It will be published at a later date. (Enter approximate date, if known).
- ☐ Other. (Give Reason)

DoD Directive 5230.24, "Distribution Statements on Technical Documents," 18 Mar 87, contains seven distribution statements, as described briefly above. Technical Documents must be assigned distribution statements.

Cynthia Gleisberg  
 Authorized Signature/Date

Cynthia Gleisberg  
 Print or Type Name  
334-1255-2924  
 Telephone Number

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TR 84-3	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  Analysis of Tracked Vehicle Run-Over Accidents		5. TYPE OF REPORT & PERIOD COVERED  Technical Report
		6. PERFORMING ORG. REPORT NUMBER N/A
7. AUTHOR(s)  LTC Francis G. Sisk MSG William A. Throckmorton		8. CONTRACT OR GRANT NUMBER(s)  N/A
9. PERFORMING ORGANIZATION NAME AND ADDRESS Commander US Army Safety Center Ft. Rucker, AL 36362-5363		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS  N/A
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE June 1984
		13. NUMBER OF PAGES 7
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A
16. DISTRIBUTION STATEMENT (of this Report) This report is classified "Unclassified" and is available to the public. It is not to be distributed outside the Army Safety Center, Ft. Rucker, Alabama.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Safety Tracked Vehicle Accidents Ground Guides Run-Over Accidents Armored Personnel Carrier Tanks Self Propelled Howitzers Tank Retrieval Vehicles		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) An analysis of accidents in which personnel were run-over by tracked vehicles found that two factors accounted for all 30 accidents. These two factors are: Inadequate Ground Guiding (70%) and Inadequate Coordination/Communication (30%). These two factors and general findings from tracked vehicle run-over accidents are discussed.		

## Analysis of Tracked Vehicle Run-over Accidents

### INTRODUCTION

The purpose of this analysis was to determine common threads which link accidents where personnel were run-over by Army combat tracked vehicles.

### METHOD

An analysis<sup>1</sup> of FY 82 tracked vehicle accidents found nine factors that accounted for 86% of 262 accidents; I - Inadequate inspection and testing (23%); II - Following too closely (3%); III - Improper passing (3%); IV - Excessive speed for conditions (15%); V - Night/excessive duty hours (11%); VI - Narrow/congested roads (8%); VII - Inadequate coordination/communication (12%); VIII - Rough terrain (7%); and IX - Improper ground guiding (4%).

Since these nine factors accounted for such a large proportion of FY 82 accidents, it was decided to determine if they also accounted for a large proportion of accidents in which personnel were run-over by tracked vehicles.

A computer search was made to identify accidents involving personnel injured as a pedestrian by a tracked vehicle during the period 1 October 1980 through 24 March 1984. The search revealed 82 such accidents reported to the US Army Safety Center on DA Forms 285 and 285-1 (United States Army Accident Investigation Report).

Of the 82 accidents, 30 involved personnel being run-over by a tracked vehicle, 28 involved personnel being pinned by a tracked vehicle, and 24 involved injuries which did not result from being run-over or pinned. The 30 run-over accidents were reviewed to determine common cause factors.

Two Army personnel experienced in tracked vehicle operations categorized the 30 accidents by the nine factors from the FY 82 analysis according to the factor that each accident best fit; i.e., the problem described by the factor was a key cause of the accident. The accident vehicles were grouped for analysis by operational type: Carriers (M113, M106, and M548), Weapons Systems (M109, M110, M901, and M42), and Tank/VTR (M60 and M88).

---

<sup>1</sup>Sisk, F. G., Throckmorton, W. A., and Ricketson, D. S., Analysis of FY 82 M113 APC and M60 Tank Accidents. US Army Safety Center Technical Report No. 84-1, Fort Rucker, Alabama, 1983.

## RESULTS

Table 1 shows the 30 accidents accounted for nine fatal and 22 non-fatal injuries with a total cost of \$703,860. Carriers accounted for 63% of the accidents, 67% of the fatalities, 64% of the non-fatal injuries, and 63% of the cost. Table 2 reveals that two FY 82 factors accounted for all of the 30 run-over accidents: Improper Ground Guiding (21/70%), and Inadequate Coordination/Communication (9/30%). Tables 3 and 4 present the accident information that was found important in interpreting the two factors.

In addition to the two factors, the following are general findings from Tables 5, 6, and 7.

1. US Army Forces Command (FORSCOM) accounted for 57% of the run-over accidents, US Army Europe (USAREUR) for 30%, and Army National Guard (ARNG) for 13%.

2. Human error caused or contributed to all of the 30 accidents and environmental conditions contributed to 80%. It should be noted these causes sum to more than 100% because an accident can have more than one cause.

3. Almost two-thirds (63%) of the accidents occurred in training areas.

4. A larger than expected proportion (27%) of the accidents took place on ranges.

5. Two series of vehicles accounted for 80% of the 30 accidents: 60% were M113 and M106 carriers and 20% were M109/M110 self-propelled howitzers.

6. Two-thirds (67%) of the 30 accidents happened during darkness. These were severe accidents which is evidenced by 78% of the nine fatalities occurring during darkness.

7. Lack of a ground guide accounted for 61% of the 18 accidents occurring during darkness.

8. Over half (52%/16) of all 31 injuries occurred to soldiers sleeping (14) or eating (2) in unprotected positions.

9. All nine fatalities occurred in FORSCOM units during FY 83 (3) and FY 84 (6) (as of 24 Mar 84).

10. Five site locations accounted for the nine fatalities: Ft Irwin - 3; Ft Polk - 2; Ft Hood - 2; Ft Drum - 1; and Panama - 1.

11. No ground guide was present in 78% (7) of the 9 fatal accidents.

12. Neither blackout lights nor blackout markers were used during 57% (4) of the 7 night fatal accidents when a ground guide was not present.

13. Over three-fourths (78%) of the fatalities during darkness were either sleeping (5) or eating in unprotected positions (2).

## DISCUSSION AND CONCLUSIONS

Statistical Analysis. Two factors identified in the FY 82 analysis accounted for all of the 30 tracked vehicle run-over accidents and reflect the importance and time independence of these two problem areas.

### Factors.

IMPROPER GROUND GUIDING. Table 3 reveals that this factor accounted for 21 (70%) of the accidents. The errors causing these accidents were: no ground guide present 62% (13); improper positioning of ground guide 29% (6); and improper attention of ground guide 9% (2). This factor was a key cause in 67% (14) of the 21 accidents during darkness. The average cost of these accidents (\$25.5K) was higher than the average of all accidents (\$23.5K) and is more than one-third more costly than those accidents caused by inadequate coordination/communication (\$18.6K). This was due to the severity of personnel injuries in that 89% (8) of the 9 fatalities were accounted for by this factor.

INADEQUATE COORDINATION/COMMUNICATION. Table 4 shows that this factor accounted for 9 (30%) of the accidents. The accidents were about equally split between day (56%) and night (44%). This factor was found to be less severe in terms of average cost per accident (\$18.6K versus \$23.5K for all accidents) due to the lower than expected number of fatalities 11% (1/9). The problems represented by this factor involve:

1. Track commander/driver, prior to vehicle movement, not ensuring that crew members are informed and in a proper position if outside the vehicle (5/56%).
2. Personnel exiting or entering a vehicle without informing other crew members they had done so and subsequently being run-over (4/44%).

### General.

1. Inadequate supervision was the underlying cause of all run-over accidents. All these accidents could have been prevented had the chain of command been exercised prior to the incident.

2. The high occurrence of no ground guides during darkness and no blackout lights/markers was reflected in the high number of fatal and non-fatal injuries. Training realism appears to be the common thread for not using ground guides and blackout lights.

3. A training doctrine determination is needed on the risks/benefits of not using blackout lights/markers during night-time training when night vision goggles are not available for tracked vehicle operations.

4. The need to position ground guides at a distance of 30 feet (10 yards), as discussed in FM 21-306, needs emphasis. Ground guides 12 to 15 feet forward/rearward of a tracked vehicle moving five miles per hour (7.335 feet per second) stand little, if any, chance of not being run-over if they fall.



TABLE 1 - ACCIDENTS, INJURIES, AND COST BY COMBAT VEHICLE OPERATIONAL TYPE

Type Vehicle	Accident	%	Injuries				Cost	%
			Fatal	%	Non-Fatal	%		
Carriers	19	63%	6	67%	14	64%	443,265	63%
Weapons Systems	8	27%	2	22%	6	27%	170,420	24%
Tank/VTR	3	10%	1	11%	2	9%	90,175	13%
TOTAL	30	100%	9	100%	22	100%	703,860	100%

TABLE 2 - CAUSAL FACTORS BY COMBAT VEHICLE OPERATIONAL TYPE

Causal Factor	Carriers	Weapon Systems	Tank/VTR	Total
Improper Ground Guiding	13 (68%)	6 (75%)	2 (67%)	21 (70%)
Inadequate Coordination/ Communication	6 (32%)	2 (25%)	1 (33%)	9 (30%)
TOTAL	19 (100%)	8 (100%)	3 (100%)	30 (100%)

TABLE 3 - IMPROPER GROUND GUIDING

Variables	n	%	Type Measure
No Ground Guide	13	62%	Within Factor
Improper Position of Ground Guide	6	29%	Within Factor
Improper Attention of Ground Guide	2	9%	Within Factor
Accidents	21	70%	All Accidents
Cost	\$536,630	76%	All Accidents
Fatalities	8	89%	All Fatalities
Non-Fatal Injuries	14	64%	All Non-Fatals
Darkness	14	67%	Within Factor

TABLE 4 - INADEQUATE COORDINATION/COMMUNICATION

Variables	n	%	Type Measure
TC/Driver Not Checking Position of Vehicle Occupants	5	56%	Within Factor
Entering/Exiting Vehicle Without Notifying TC/ Driver	4	44%	Within Factor
Accidents	9	30%	All Accidents
Cost	\$167,230	24%	All Accidents
Fatalities	1	11%	All Fatalities
Non-Fatal Injuries	8	36%	All Non-Fatals

TABLE 5 - GENERAL FINDINGS

Variables	n	%	Type Measure	
Human Errors	30	100%	All Cause Factors	
Environmental Factors	24	80%	All Cause Factors	
Illumination (dark)	18	60%	80%	All Accidents
Precipitation (rain, icy)	4	13%		All Accidents
Rutted, Rough Area	1	3%		All Accidents
Concealed (pine trees)	1	3%		All Accidents
Accident Locations				
Training Area	19	63%	100%	All Accidents
Range	8	27%		All Accidents
Roadway	2	7%		All Accidents
Vehicle Facility	1	3%		All Accidents
Unprotected Position				
Sleeping	14	46%	52%	All Injuries
Eating	2	6%		All Injuries
Combat Vehicle Series				
M113/M106 APC	18	60%	80%	All Accidents
M109/M110 How SP	6	20%		All Accidents
Other Vehicles	6	20%		All Accidents
MACOM				
FORSCOM	17	57%	100%	All Accidents
USAREUR	9	30%		All Accidents
ARNG	4	13%		All Accidents

TABLE 6 - DARK (NIGHT, DUSK OR DAWN)

Variables	n	%	Type Measure
Accidents During Darkness	18	67%	All Accidents
Improper Ground Guiding			
No Ground Guide	11	61%	100% All Darkness Accidents
Improper Attention	2	11%	
Improper Position	1	6%	
Coordination/Communication	4	22%	All Darkness Accidents
Fatal Injuries	7	78%	All Fatalities
Non-Fatal Injuries	12	55%	All Non-Fatals
Personnel Sleeping in Unprotected Position	14	45%	All Injuries

TABLE 7 - FATALITIES

Variables	n	%	Type Measure
FY 83	3	33%	All Fatalities
FY 84 (24 Mar 84)	<u>6</u>	<u>67%</u>	All Fatalities
TOTAL	9	100%	
MACOM			
FORSCOM	9	100%	All Fatalities
Darkness	7	78%	All Fatalities
No Ground Guides	7	78%	All Fatalities
No Blackout Lights/Markers	4	57%	Of No Ground Guides
Sleeping or Eating in Exposed Area	7	78%	All Fatalities
Site Locations			
Fort Irwin	3	34%	All Fatalities
Fort Polk	2	22%	All Fatalities
Fort Hood	2	22%	All Fatalities
Panama	1	11%	All Fatalities
Fort Drum	1	11%	All Fatalities